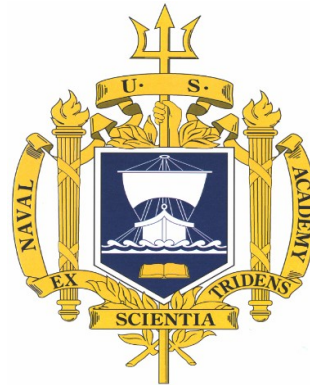

A Brief Overview of Wire Aging

Richard Witt

United States Naval Academy

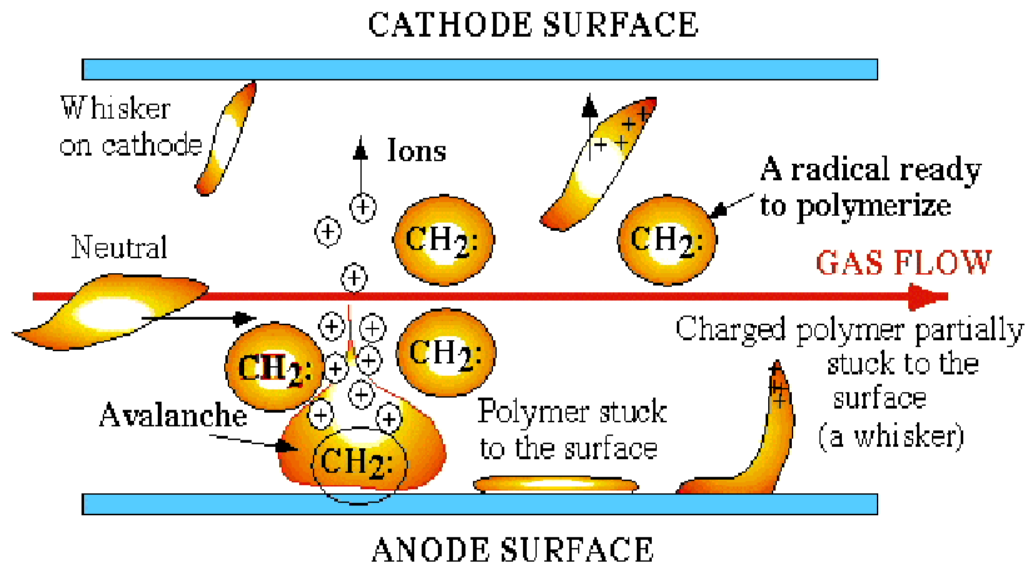


Outline

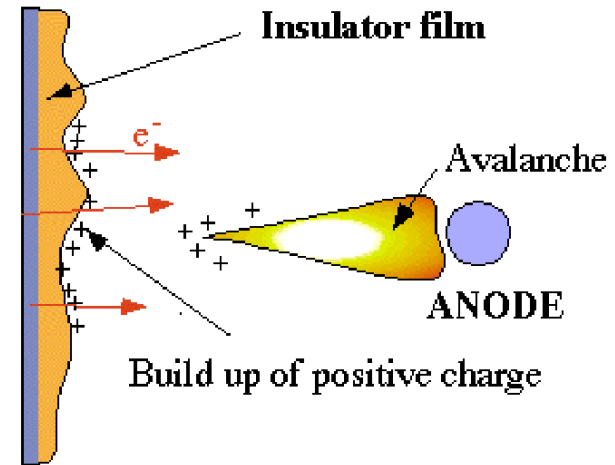
- “Classical” Aging
 - Known Contributors
- Characterization of aging
- Data on P10
- Remediations (2001 Hamburg Workshop)



"Classical" Aging



J. Vavra, Nucl. Instr. and Meth. **A515** (2003)
1.



CATHODE

J. Vavra, Nucl. Instr. and Meth. **A515** (2003)
1.

- Plasma Polymerization

- Effects that lead to:

- Reduced gain
- Lower E resolution
- Excessive currents
- Sparking

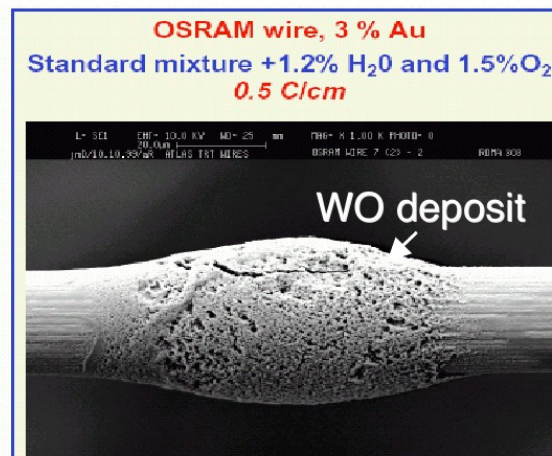
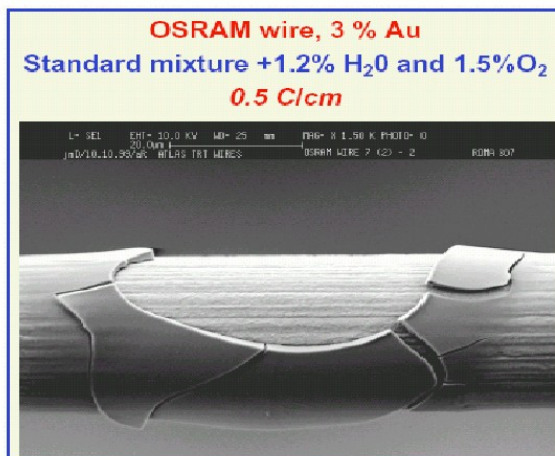
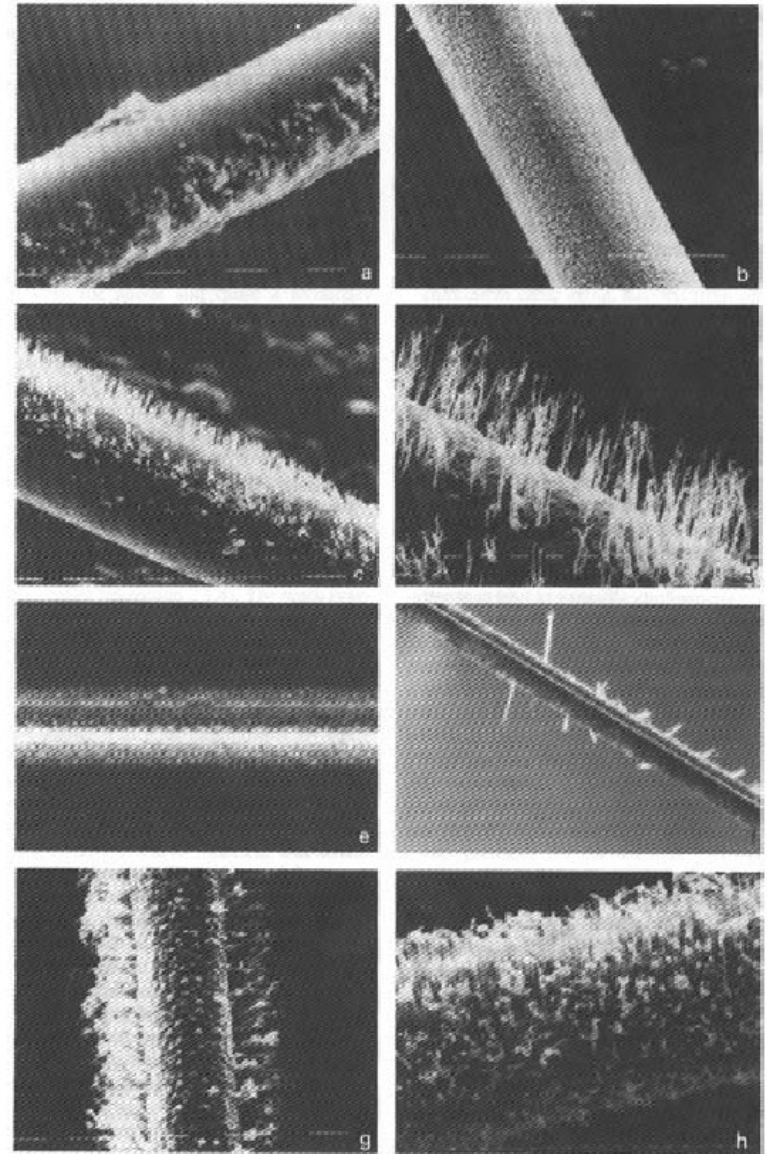
- Malter Effect

- Thin insulating layer formed on cathode
- Dark currents due to cathode emission
- L. Malter, Phys. Rev. 50 (1936) 48.

Contributing Factors

- Complex environment
- Dependence upon
 - Gas mixture and flow
 - Gas contaminants
 - Material outgassing
 - Ionization current density
 - Operational gain
- Wide variation in effects

(J. Kadyk, NIM A300 (1991) 436):



Romaniouk *et al.*, Nucl. Instr. & Meth., **A515** (2003) 166

Characterization

- Figure(s) of merit
 - Relative gain (G/G_0)
 - Pulse height, shape
 - vs. collected charge per unit length

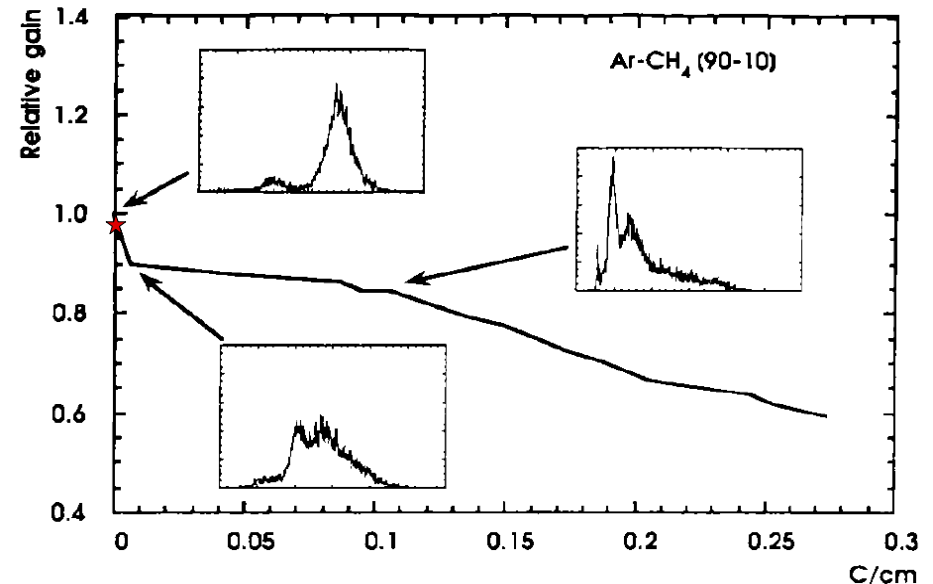
- Two parameters

$$R = \frac{-1}{G_0} \left(\frac{dG}{dQ} \right)$$

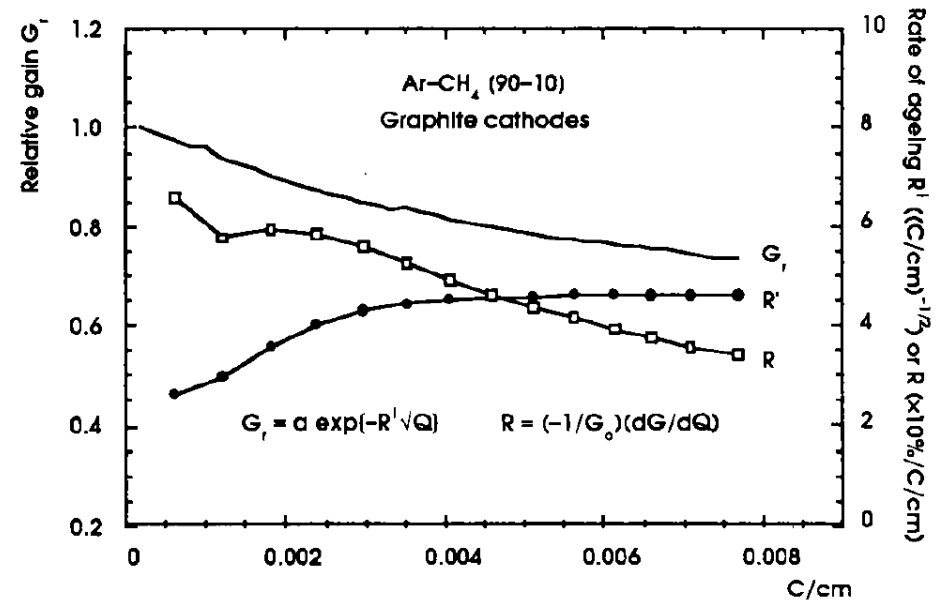
J. Kadyk, Nucl. Instr. and Meth. **A300** (1991) 436.

$$\frac{G}{G_0} = a \cdot e^{-R' \sqrt{Q}}$$

R. Bouclier, M. Capeáns, C. Garabatos, R.D. Heuer, M. Jeanrenaud, T.C. Meyer, F. Sauli, K. Silander, Nucl. Instr. and Meth. **A346** (1994) 114.



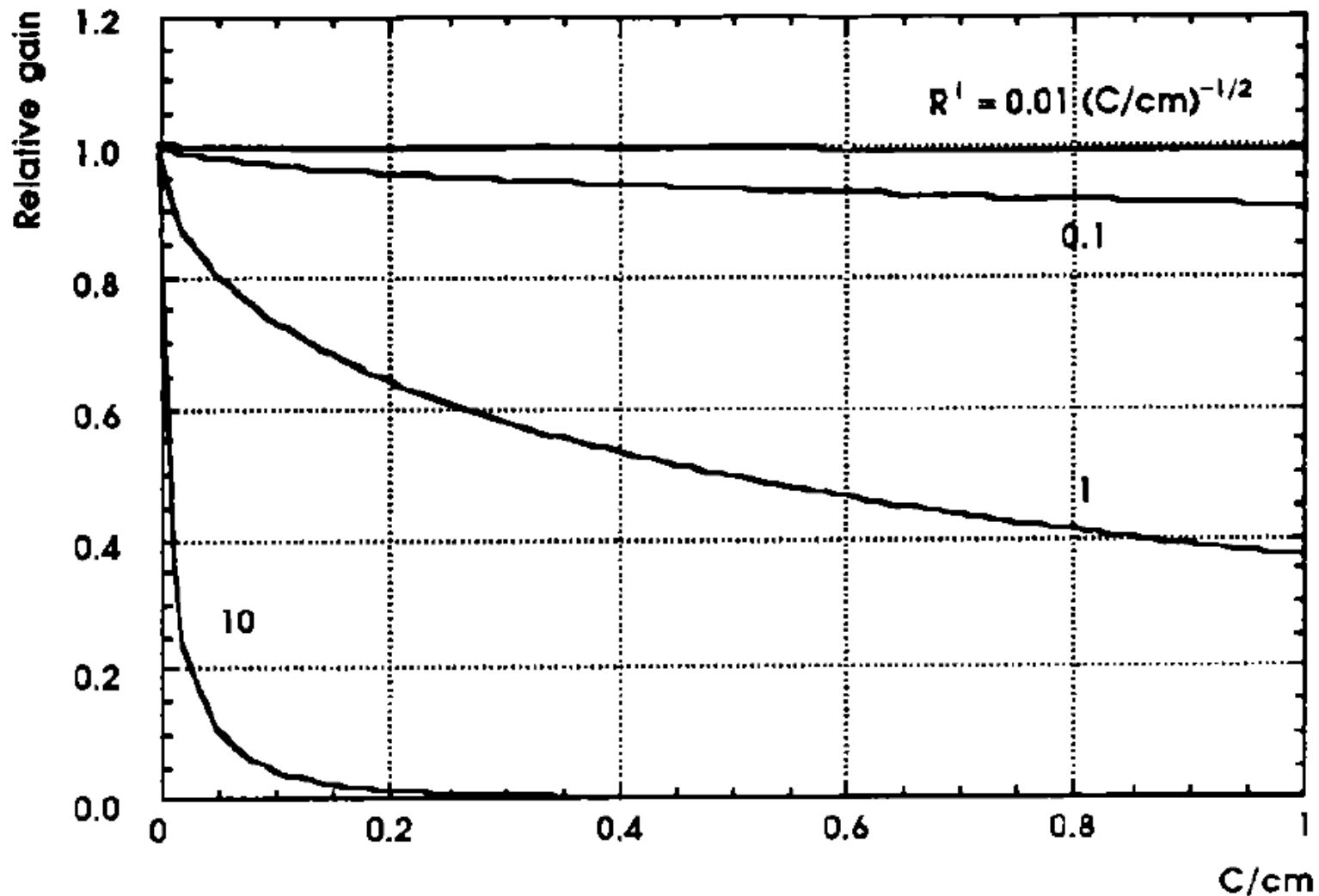
R. Bouclier, M. Capeáns, C. Garabatos, et al., Nucl. Instr. and Meth. **A346** (1994) 114.



R. Bouclier, M. Capeáns, C. Garabatos, et al., Nucl. Instr. and Meth. **A346** (1994) 114.

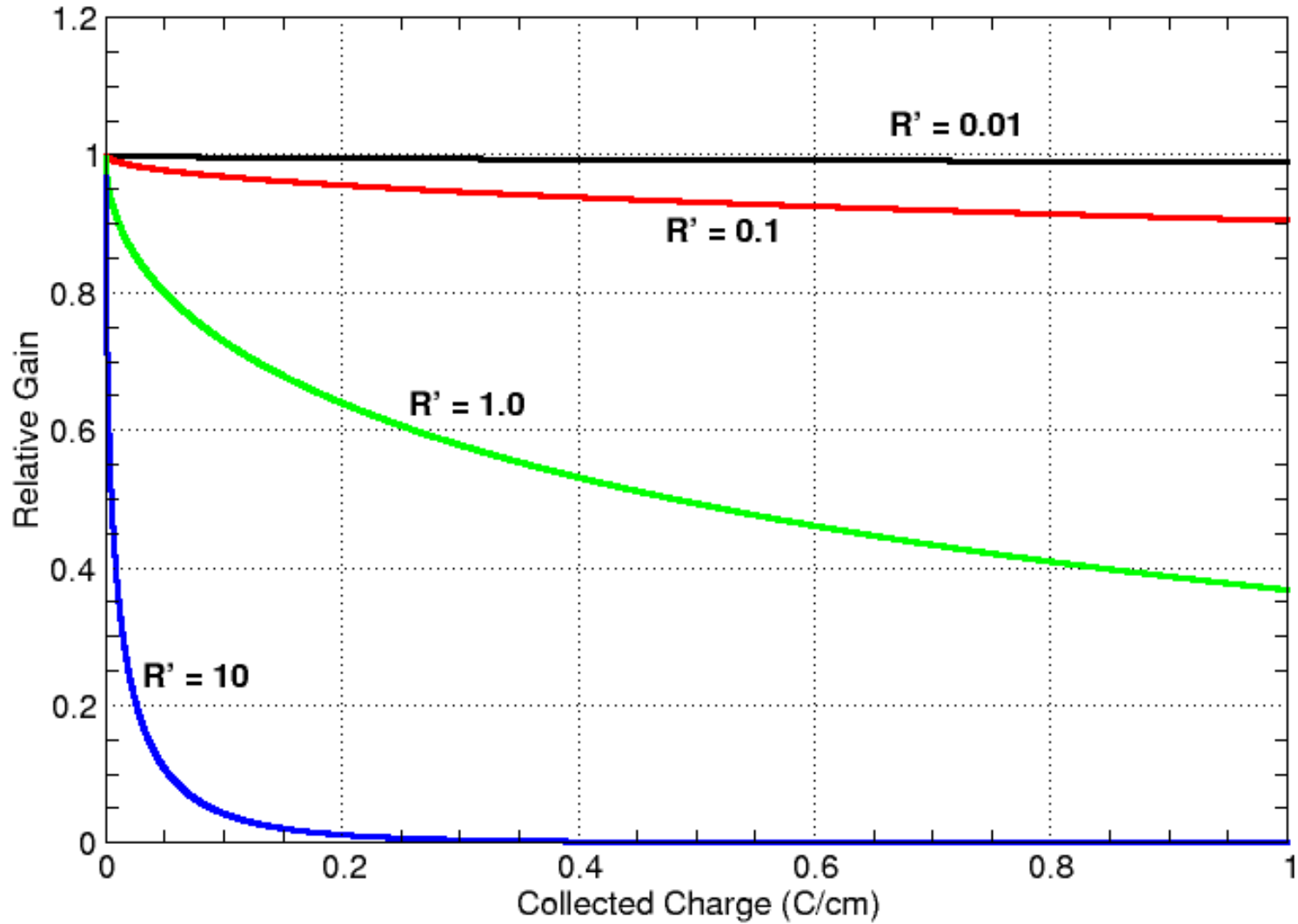


Relative Gain vs. R'

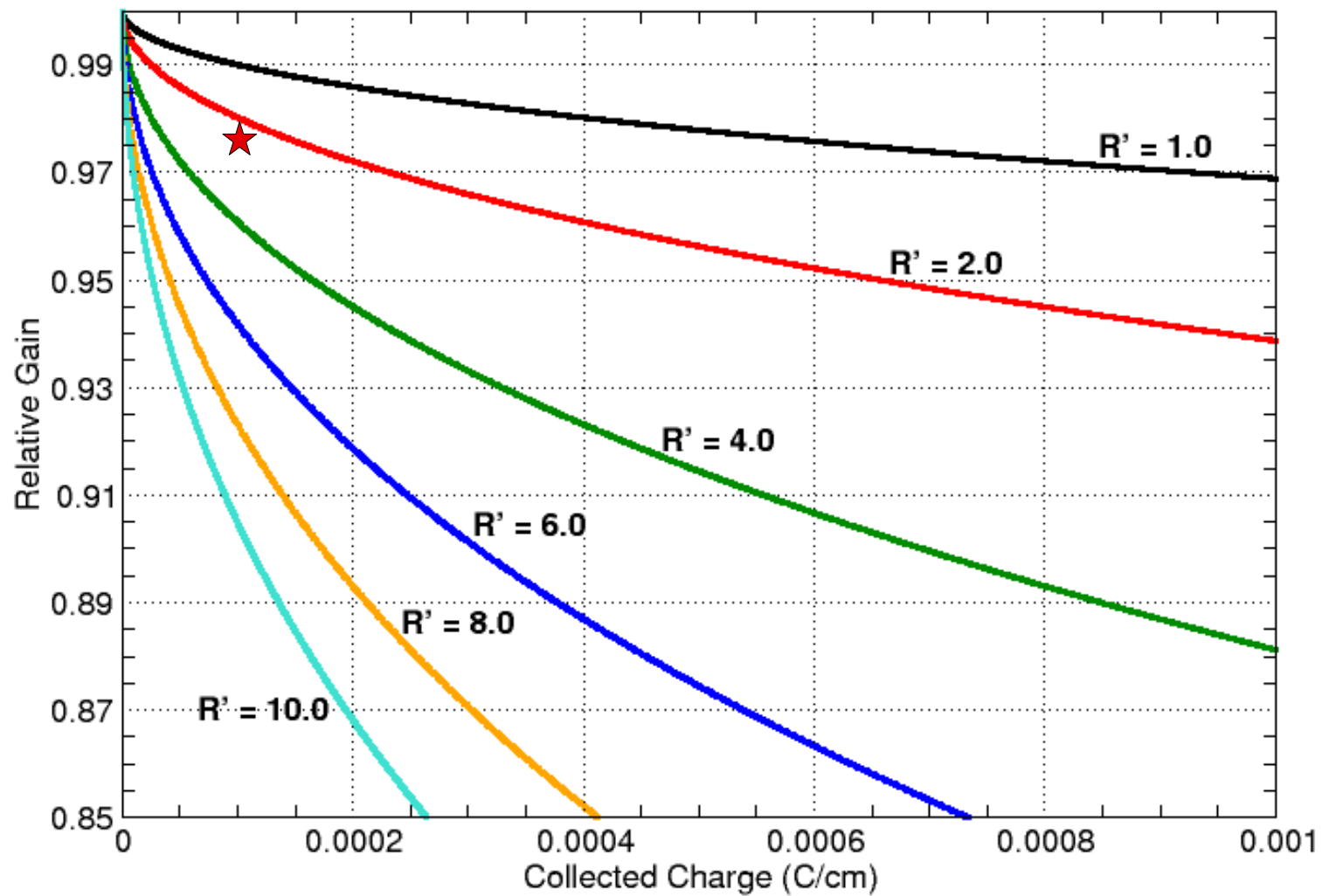


R. Bouclier, M. Capeáns, C. Garabatos, et al., Nucl. Instr. and Meth. **A346** (1994) 114.

Relative Gain vs. R'

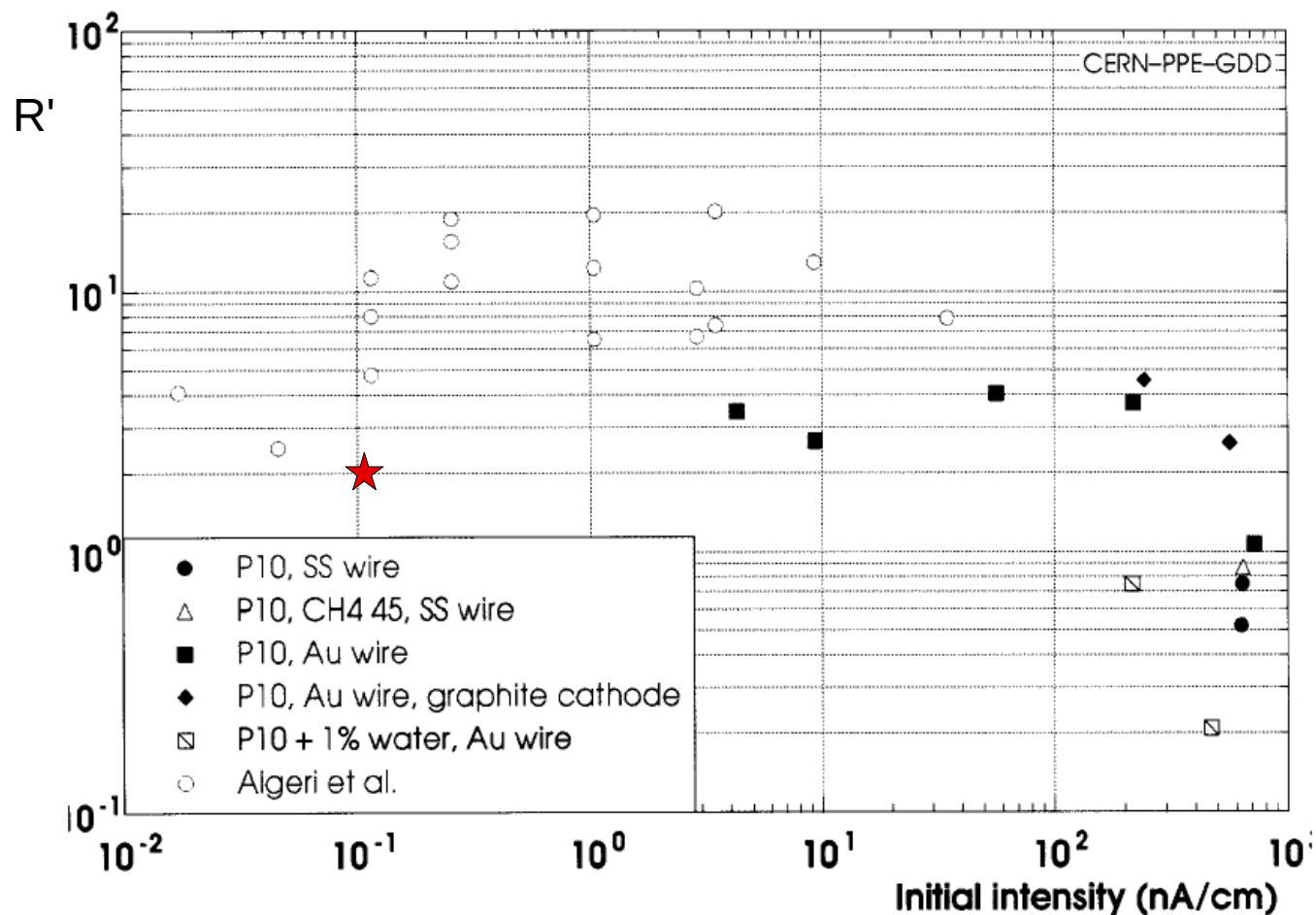


Relative Gain vs. R'



Data from P10 Tests

Summary of aging results with P10



M. Capeáns, S. Konovalov, A. Romaniouk, PH-EP-Tech-Note-2009-002.



Remediation

- Methods mentioned in the Hamburg Workshop
 - Heating of wires with external current source
 - Worked for oily deposits
 - J. Va'vra, Nucl. Instr. and Meth. **A387** (1997) 183.
 - Sublimation products adversely affected their RICH
 - High voltage pulse
 - T. Marshall (D0 collab.), Nucl. Instr. and Meth. **A515** (2003) 50.
 - Charged capacitor (few tens of joules) discharged through wires
 - Products?
 - Addition of oxygen (or CO₂)
 - A.M. Boyarski, Nucl. Instr. and Meth. **A515** (2003) 190.
 - Effectively "burns" away organic deposits

